1980; Brinson *et al.* 1981, 1983, 1984) have emphasized nutrient processing by litter and soils during flooding events rather than nutrient removals by these wetland systems on an annual basis. One study, however, showed losses of N and P downstream of waste-water outfalls in two Coastal Plain swamp streams (Kuenzler 1987). Nutrient concentrations usually decreased downstream much faster than did the conservative element chloride, demonstrating net nutrient removal from the water, not simply dilution. During flooding events, rapid change in nutrient concentration downstream resulted primarily from dilution, but when the streams were low the nutrients decreased much faster than chloride. At both sites, nutrient concentrations declined significantly within a few hundred meters of the outfall, and were essentially undetectable 4 km downstream. Use of this method of determining net nutrient removal permitted interpretation of results where data on hydrology and total nutrient loading rates were lacking.

The published literature shows that Southeastern forested wetlands can remove major percentages of suspended sediments from cropland runoff and N and P from both point- and non-point sources of pollution (Kitchens *et al.* 1975; Boyt *et al.* 1977; Ewel and Bayley 1978; Tietjen and Carter 1981; Kemp and Day 1984; Lowrance *et al.* 1984; Peterjohn and Correll 1984; Yarbro *et al.* 1984; Chescheir *et al.* 1987; Kuenzler 1987, 1988). Kuenzler and Craig (1986) used a mass-balance model of wetland nutrient removals to estimate downstream impacts of nutrient loading from different land uses in the Chowan River. Much of the nutrient yield from agricultural and municipal sources in the watershed is apparently removed by forested riparian wetlands before reaching the estuary. Improved understanding of rates and controls of nutrient removal by wetland systems along Coastal Plain streams will aid in determining their importance in maintaining estuarine water quality.

NUTRIENT DECREASES IN WETLANDS BELOW OUTFALLS

Three major processes decrease nutrient concentrations below wastewater outfalls. First, there is dilution of the wastewater with stream- or ground-water. This reduces solute and particle concentrations, although the quantity carried by the stream, and thus the downstream load, actually increases. Furthermore, the soil and wetland biota take up some nutrients by processes such as abiotic sorption or fixation (*e.g.*, phosphate), microbial immobilization, and plant uptake. Finally, there is mass efflux of some elements from the wetland to the atmosphere; methanogenesis and denitrification, for example, remove carbon and nitrogen, respectively. The first process is neither removal from the water nor retention in the system, the second is removal and retention, the third is removal from the water but not retention. The term "removal"